

**US-191 - Colorado River Bridge**  
**Project No.: BHF-0191(27)129E**

**Noise Analysis**  
**for**  
**Bridge / Roadway**  
**Reconstruction and Widening on**  
**US-191, from 400 North in Moab City**  
**to SR-279 (Potash Road)**  
**in Grand County, Utah**

**Utah Department of Transportation**  
**May 2006**  
**Amended February 2007**

Submitted by:

Michael Baker Jr., Inc.  
6955 Union Park Center, Suite 370  
Midvale, UT 84047  
(801) 255-4400

## TABLE OF CONTENTS

1.0 INTRODUCTION .....	1
2.0 FUNDAMENTALS OF SOUND AND NOISE.....	1
3.0 LOCAL AREA LAND USES.....	3
4.0 NOISE IMPACT CRITERIA .....	3
5.0 NOISE LEVEL MEASUREMENTS.....	4
6.0 METHODOLOGY .....	5
7.0 ASSUMPTIONS FOR TRAFFIC DATA .....	6
8.0 EXISTING NOISE ENVIRONMENT .....	6
9.0 DESIGN YEAR NO BUILD ALTERNATIVE ENVIRONMENT .....	7
10.0 DESIGN YEAR BUILD ALTERNATIVE ENVIRONMENT .....	7
11.0 TRAFFIC NOISE ABATEMENT .....	16
11.1 TRAFFIC MANAGEMENT MEASURES.....	17
11.2 ALTERATION OF HORIZONTAL AND VERTICAL ALIGNMENTS.....	17
11.3 ACQUISITION PROPERTY RIGHTS FOR BARRIER CONSTRUCTION.....	17
11.4 CREATION OF BUFFER ZONES.....	17
11.5 SOUND INSULATION FOR PUBLIC INSTITUTIONS.....	18
11.6 NOISE BARRIERS .....	18
11.7 CONCLUSIONS .....	22
12.0 CONSTRUCTION NOISE ABATEMENT.....	22

## APPENDICES

### APPENDIX A – PREDICTED EXTERIOR SOUND LEVELS (dBA) EXISTING AND DESIGN YEAR CONDITIONS

## LIST OF TABLES

Table 1: Noise Abatement Approach Criteria.....	4
Table 2: Measured Sound Levels.....	5
Table 3: Receptors that Approach, Equal, or Exceed the NAC.....	16
Table 4: Worst-Case 65 and 70 dBA Contour Distances (in feet).....	18
Table 5: Preliminary Noise Abatement Mitigation Summary.....	20
Table 6: Typical Construction Equipment Noise.....	23

## LIST OF FIGURES

Figure 1: Common Outdoor and Indoor Noise Levels.....	2
Figure 2: Analyzed Receptor Sites.....	8

## 1.0 INTRODUCTION

---

A noise analysis was undertaken to identify and evaluate the potential noise impacts of the proposed project. The analysis was amended in February 2007 to include potential noise impacts of the proposed project for two commercial business properties that were previously assumed to be acquired as part of the right-of-way. The first is Moab Desert Adventures (receptor 3A), located in between receptors 2 and 6 near the southern terminus of the project. The second is a commercial office building located at 550 North Main adjacent to receptor 13 (the North Main Shopping Center). For the purpose of this analysis, the four businesses located within the office building at 550 North Main are reflected as one commercial receptor. Additionally, the text in Table 5 in Chapter 11.6 regarding receptor 11 (Adventure Inn) was modified to identify the on-site residence within the Inn's office building. This hotel receptor (including the residence) is a Category B receptor site.

This analysis identifies the basic fundamentals of noise, noise sensitive areas contiguous to the project, impact criteria prescribed by Federal Regulations and the Utah Department of Transportation (UDOT), UDOT recommended analysis procedures specific to this project, and assumptions used for traffic data.

Additionally, it contains quantitative modeling results of the existing, design year No Build, and design year Build Alternative. A comparison of the predicted design year Build Alternative sound level environment is made to the existing and design year No Build environments and to the Federal Highway Administration (FHWA) and UDOT noise abatement criteria. Construction impacts are also described.

Finally, the analysis includes noise abatement consideration measures and those likely to be incorporated in the project, related coordination, and an overall summary. Noise issues for which no prudent solution is reasonably available are also discussed in detail. Under UDOT R930-3-5 Noise Abatement Conditions (3) (e), Noise abatement shall not be planned for Land Use Category C. However, the receptors must still be identified and analyzed according to UDOT policy.

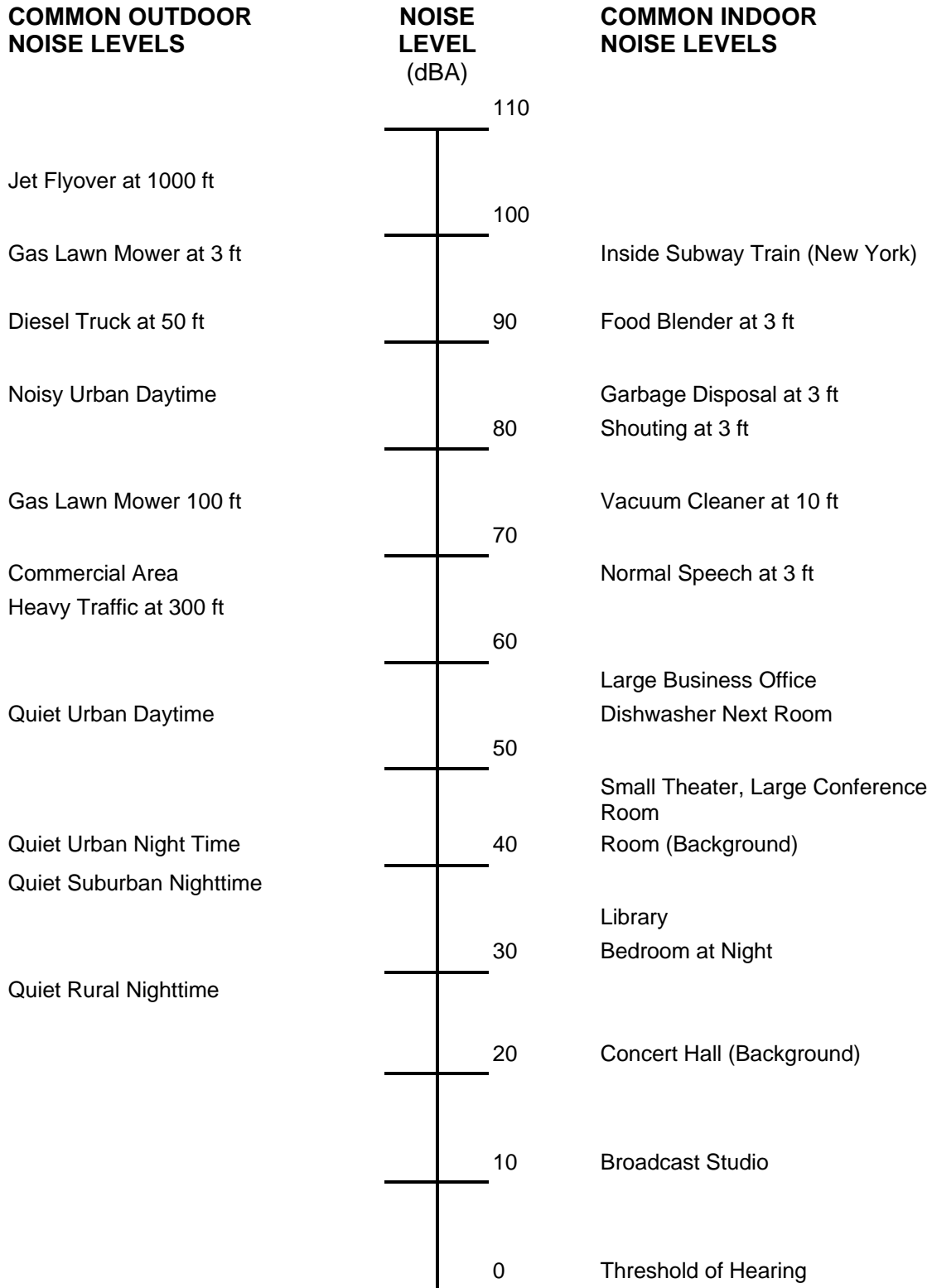
## 2.0 FUNDAMENTALS OF SOUND AND NOISE

---

Sound is the vibration of air molecule waves similar to ripples on water. When these vibrations reach our ears, we hear what we call sound. Objects that move back and forth very rapidly, such as vocal chords when we speak produce these waves. The rate at which these objects move is called their frequency. Human ears can only hear sound waves with a frequency between approximately 20 cycles per second and 15,000 cycles per second. The word "noise" is typically defined as unwanted sound.

The loudness of sound is measured in units called decibels (dB). However, since the human ear does not hear sound waves of different frequencies at the same subjective loudness, an adjustment (weighting) of the high- and low-pitched sounds is made to approximate human

**Figure 1: Common Outdoor and Indoor Noise Levels**



Source: FHWA, Highway Noise Fundamentals, September, 1980.

perception. When such adjustments to the sound levels are made, they are called “A-weighted levels” and are labeled “dBA.” **Figure 1** illustrates some common A-weighted noise levels.

The dBA scale for measuring the intensity of sound is based on the logarithm or sound level pressure relative to a reference pressure. Logarithmic scales are based on powers of ten, not linear like a ruler. Generally, a 3 dBA change is the threshold on which a typical person can hear a change in the sound level environment, a 5 dBA change is considered noticeable and a 10 dBA change in the sound level is equivalent to a doubling (or halving) of the sound level.

Additionally, the level of highway traffic noise is never constant; therefore, it is necessary to use a statistical descriptor to describe the varying traffic noise levels. The equivalent continuous sound level ( $L_{eq}$ ) (h) dBA is the statistical descriptor used in this report. The  $L_{eq}$  sound level is the steady A-weighted sound energy that would produce the same A-weighted sound energy over a stated period of time (1-hour (h), in this case) as a specified time-varying sound.

### 3.0 LOCAL AREA LAND USES

---

The land use immediately near the proposed project consists of a mixed use commercial, residential, and recreation. The density is heaviest in the southern part of the project area and rather sparse in the northern area.

### 4.0 NOISE IMPACT CRITERIA

---

Title 23 of the Code of Federal Regulations Part 772 (23 CFR 772) defines traffic noise impacts as “impacts which occur when predicted traffic noise levels approach or exceed Noise Abatement Criteria (NAC), or when the predicted traffic noise levels substantially exceed the existing noise levels.” **Table 1** shows the UDOT and FHWA Noise Abatement Criteria reflecting UDOT’s approach criteria levels. UDOT considers a traffic noise level approaching the NAC if the noise levels at a receptor come within 2 dBA of the NAC, or if the project increases noise levels by 10 dBA.

Potential substantial increase impacts at sensitive receptors were also analyzed. UDOT’s substantial increase criteria impacts are defined as a 10 dBA (or more) increase over the existing condition. For this project, a typical widening endeavor, there were no substantial increase criteria impacts as a result of the proposed improvements.

**Table 1: Noise Abatement Approach Criteria\***

HOURLY A-WEIGHTED SOUND LEVEL - DECIBELS (dBA)			
Activity Category	L <sub>eq</sub> (h) dBA*	L <sub>10</sub> (h) dBA*	Description of Land Use Category
A	55 (exterior)	58 (exterior)	Lands on which serenity and quiet are of extraordinary significance and serve an important public need and where the preservation of those qualities is essential if the area is to continue to serve its intended purpose.
B	65 (exterior)	68 (exterior)	Picnic areas, recreation areas, playgrounds, active sports areas, parks, residences, motels, hotels, schools, churches, libraries, and hospitals.
C	70 (exterior)	73 (exterior)	Developed lands, properties, or activities not included in Categories A or B above.
D	-	-	Undeveloped lands.
E	50 (interior)	53 (interior)	Residences, motels, hotels, public meeting rooms, schools, churches, libraries, hospitals, and auditoriums.

*\*Reflects UDOT's approach criteria levels since a noise impact occurs at this level. Either Leq(h) or L10(h) (but not both) may be used on a project.*

*Note: Tabulated sound levels are threshold values used to define impact and where abatement will be considered. Noise abatement will be designed to achieve a substantial noise reduction - not necessarily achieving the noise abatement criteria.*

*Source: Michael Baker, Jr., Inc., 23 CFR 772, and UDOT.*

## 5.0 NOISE LEVEL MEASUREMENTS

Sound level measurements were made at 8 representative sites using a Metrosonics dB-312 Sound Level Analyzer during peak traffic hours. The calibration of the Sound Level Analyzer was checked with its complementing Metrosonics Acoustical Calibrator before and after each measurement was taken. After samples of the noise level had been collected, the analyzer computed the L<sub>eq</sub> noise level for the period during which the samples were collected. The field results are presented in **Table 2**.

Measurements were performed for this project under the direction of current UDOT and FHWA guidance. These field measurements were used to validate and calibrate the model to the predicted field conditions.

**Table 2: Measured Sound Levels**

<b>Monitoring Site Number</b>	<b>Land Use</b>	<b>Location</b>	<b>Measured Sound Level (dBA)</b>	<b>Model Validated Sound Level (dBA)</b>	<b>Variance</b>	<b>Dominant Noise Source</b>
1	Recreational	Lions Park	56	59	+3	US-191
2	Recreational	Riverside Oasis Campground	61	63	+2	US-191, campground maintenance
3	Recreational	Slickrock Campground & RV Park	58	61	+3	US-191
4	Residential	500 West, behind Denny's	60	57	-3	US-191, local traffic
5	Residential, Resort, Restaurant	Moab Springs Condos	62	61	-1	US-191
6	Residential, Commercial	North Cermak Road	55	52	-3	US-191
7	Residential	Mivida Drive	57	57	0	US-191, Local Traffic
8	Residential	Rosalie Court	59	59	0	US-191

*Source: Michael Baker Jr., Inc., Nov., 2005*

## 6.0 METHODOLOGY

Estimates of the exterior noise levels at sensitive receptors in the vicinity of the proposed project were based on the FHWA approved Traffic Noise Model (TNM), version 2.5. The modeling predicted the sound levels for the existing year, design year No Build, and design year Build Alternative. In making these estimates, the traffic volume, fleet mix, operating speed, tree shielding, shielding from buildings, terrain, ground zones, and site elevation were considered.

Category B receptors were analyzed as part of this project. These receptors typically include picnic areas, recreation areas, playgrounds, active sports areas, parks, residences, motels, hotels, schools, churches, libraries, and hospitals.

Typically, commercial and industrial sites (Category C receptors) are not considered sensitive noise sites. Typically, these establishments do not want to have their visibility blocked from the roadway for business purposes. As a result, proposed mitigation when only in the form of noise barriers, may be unlikely and typically undesired. Title 23 CFR 772.11(a) states that in determining and abating traffic noise impacts, primary consideration is to be given to exterior areas. Abatement will usually be necessary only where frequent human use occurs and a

lowered noise level would be of benefit. Additionally, under UDOT R930-3-5 Noise Abatement Conditions (3) (e), Noise abatement is not be planned for Land Use Categories C.

Additionally, where no bonafide exterior sites existed at various Category B or C sites, the Category E criteria were applied. Table 12 (page 117) in the FHWA Highway Noise Fundamentals Training Document identifies the representative outside to inside noise reduction for Category E receptors. For open window scenarios, it is listed as 20 dBA. For closed windows, it is listed as 30 dBA. Since existence or non-existence of windows at these locations, the temperature, the season, and / or personal preference for open / closed windows varies for each location, a conservative 25 dBA value was used as an average between the two suggested values.

Finally, estimates of the 65 and 70 dBA sound level contour were made for the design year Build Alternative for future planning purposes.

## 7.0 ASSUMPTIONS FOR TRAFFIC DATA

---

Traffic data was obtained from the traffic analysis conducted for the US-191 Colorado River Bridge Study, Project No. BRF-0191(23)128, dated October, 2004. Paragraph b, Section 772.17 of 23 CFR 772 states that, "in predicting noise levels and assessing noise impacts, traffic characteristics which will yield the worst hourly traffic noise impact on a regular basis for the design year shall be used." Since the level of highway traffic noise is normally related to the traffic volume, the traffic characteristics that yield the worst hourly traffic noise impact on a regular basis for the design year will be the peak hourly volume for the highest hour of the day. For planning purposes, the peak hour traffic volume was estimated to be 14% of the Average Daily Traffic (ADT).

## 8.0 EXISTING NOISE ENVIRONMENT

---

Approximately 70 receptor representing about 80 total receptors / dwelling units were modeled in the immediate vicinity of the project corridor. These included second and third row receptors that may potentially be affected by the proposed improvement. Of these 70 sites, approximately 20 are commercial businesses, eight are motels, five are campgrounds and / or recreational parks, one church, and the rest are residential dwelling units.

There are nine receptors that have sound levels that approach, equal, or exceed the UDOT criteria in the existing year. These include one single family residence (2 Rosalie Court), two motels (Days Inn and Adventure Inn) and six commercial businesses (Moab Desert Adventures, Office Building at 550 North, Cycle Shop, Maverick Shop, Poison Spider, and Century 21). **Table 3** shows the total number of receptors that approach, equal, or exceed the UDOT criteria. Appendix A summarizes the existing sound levels at each receptor.

## 9.0 DESIGN YEAR NO BUILD ALTERNATIVE ENVIRONMENT

---

There are ten receptors that have sound levels that approach, equal, or exceed the UDOT criteria in the design year No Build condition. These include two motels, two single family residences and six commercial businesses. In addition to the receptors impacted in the existing year, the single family residence at 3 Rosalie Court is also impacted in the design year No Build condition. On average, the increase over the existing condition is about 2 dBA (0-3 dBA range). **Table 3** shows the total number of receptors that approach, equal, or exceed the UDOT criteria. Appendix A summarizes the existing sound levels at each receptor. (Please note that these sound levels are rounded.)

## 10.0 DESIGN YEAR BUILD ALTERNATIVE ENVIRONMENT

---

There are 11 receptors that have sound levels that approach, equal, or exceed the UDOT criteria in the design year Build condition. These include three motels, two single family residences, and six commercial businesses. In addition to the receptors impacted in the design year no-build condition, the Hampton Inn is also impacted in the design year Build condition. **Table 3** shows the total number of receptors that approach, equal, or exceed the UDOT criteria. Appendix A summarizes the existing sound levels at each receptor. (Please note that the sound levels in Appendix A are rounded.)

The average sound level change is approximately 2 dBA (0-6 dBA range) over the No Build condition and approximately 4 dBA (0-8 range) over the existing year. These sound level changes are primarily the result of a combination of the following variables: minor alignment centerline shifts closer or farther away from noise sensitive sites, changes to the posted speed limit (depending on the section), the addition of through lane capacity, existing shielding, and the added reflective surface (additional lane, center turning lane, shoulders, bike trail, etc.). **Figure 2** shows the analyzed receptor sites in the project area.

**Table 3: Receptors that Approach, Equal, or Exceed the NAC**

NAC Category	Existing Year	Design Year 2030 No Build	Design Year 2030 Build*
B	3	4	5
C	6	6	6
E	0	0	0
<u>Total</u>	<u>9</u>	<u>10</u>	<u>11</u>

*\*FHWA / UDOT NAC impacts only. There are no predicted UDOT substantial increase criteria impacts.*

*Source: Michael Baker Jr., Inc.*

## **11.0 TRAFFIC NOISE ABATEMENT**

Steps should be taken to ensure that reasonable and feasible abatement measures are incorporated into the plans and specifications. UDOT will typically not approve the environmental documentation and plans and specifications unless such measures are identified and incorporated to reduce or eliminate the noise impact on existing activities, developed lands, or undeveloped lands for which development is planned, designed, and programmed as of the date of environmental approval.

Typically, commercial and industrial sites (Category C receptors) are not considered sensitive noise sites. Though they were tabulated for total impacts, there were no bonafide exterior people activity area sites at these locations (parking lots do not count). Additionally, these establishments typically do not want to have their visibility blocked from the roadway for business purposes. As a result, proposed mitigation when in the form of noise barriers, may be unlikely and typically undesired. Title 23 CFR 772.11(a) also states that in determining and abating traffic noise impacts, primary consideration is to be given to exterior areas. Abatement will usually be necessary only where frequent human use occurs and a lowered noise level would be of benefit. As a result, Category C receptors were dismissed from further abatement consideration. And furthermore, under UDOT R930-3-5 Noise Abatement Conditions (3) (e), Noise abatement is not to be planned for Land Use Category C (commercial / industrial businesses operations).

The following noise abatement measures have been considered according to FHWA guidelines at the impacted sensitive receptor locations for Type I noise projects (projects that add capacity) to reduce highway-generated noise impacts. These include traffic management measures, alteration of horizontal and vertical alignments, acquisition of property rights for construction of sound walls, creation of buffer zones, sound insulation for public institutions, and construction of noise barriers or devices (including landscaping for aesthetic purposes) within the highway right-of-way.

## **11.1 TRAFFIC MANAGEMENT MEASURES**

Traffic management in the form of speed reduction, detours, truck restrictions, and exclusive lane designations is not practical abatement for this project. Speed reduction is not considered effective because changes are already expected for both the design year no-build and build alternatives in various parts of the project area. Comparably, truck detours and restrictions are not reasonable because it is an important north-south arterial. As a result, it would not help to serve the need to move people, goods, and services in the area. Exclusive lane designations for trucks and buses are also not effective for this project because making every heavier / louder vehicle use the right lane exclusively would move this sound level generation closer to the sensitive receptors.

## **11.2 ALTERATION OF HORIZONTAL AND VERTICAL ALIGNMENTS**

Modifications to the horizontal and vertical alignment would be bound by the engineering limitations required within the relative and reasonable right-of-way (existing and proposed) and the existing corridor that the project currently occupies.

Horizontal modifications to reduce sound levels at impacted locations would require large shifts in the alignment, potential changes to the super-elevation, and would require a realignment of the cross-streets for proper approach angles, taking even more property. In addition to the property acquisition, this would also require removing more buildings, which act as noise shielding for some residences in the study area that are farther removed from the immediate roadway. The topography in the project area is also a constraint because of the steep slopes.

Vertical alignment alteration was also not considered to be a feasible noise abatement measure. Depressing the roadway would also entail impacts similar to horizontal changes, such as property acquisition to maintain proper slopes and cross-street connections. There would also be probable variances with the utilities and water features. Elevating the roadway would only propagate the sound levels deeper into the residential areas and would reduce the effect of right-of-way shielding from existing trees or buildings.

## **11.3 ACQUISITION PROPERTY RIGHTS FOR BARRIER CONSTRUCTION**

Much of the proposed project would be constructed in the existing right-of-way. Where additional land is required, it is likely to incorporate enough property to integrate the necessary sloping. As a result, no additional property for any proposed barrier construction is foreseen, if applicable. If this condition changes, then the mitigation analysis would be reviewed to see if it creates a situation where additional land is needed. Otherwise, it is anticipated that any planned reasonable and feasible barriers would be accommodated within the proposed right-of-way.

## **11.4 CREATION OF BUFFER ZONES**

The project corridor immediately near US-191 is a mix of commercial, residential and recreational land uses. Where active commercial or non-residential building areas already exist, then a buffer is already present to shield sensitive sites farther away from US-191. Where

abutting residential or other sensitive areas exist, it is unlikely that commercial activities will be proposed in these areas and buffer zones cannot be proposed. For non-planned or non-permitted undeveloped land, it is suggested that commercial development be proposed in future land use zoning to create a buffer zone between US-191 and sensitive areas. Nonetheless, in an effort to help create a buffer zone for future planning purposes of undeveloped land, the worst-case 65 and 70 dBA contours for the build alternative were developed for the two sections of US-191 that are proposed to operate at different speeds.

**Table 4** shows these distances. The distances are from the proposed roadway centerline and are a straight-line distance estimate for planning purposes only. They do not take into account sound level variations as a result of numerous local sound wave changing dynamics such as building shielding, terrain, tree zones, and ground zone changes (such as parking lots, for example). It does, however, incorporate the effects of the additional noise reflective pavement proposed from the construction of center turning lanes, shoulders, and bike paths, as applicable. Additionally, the distances are rounded to the nearest 10 feet for planning convenience purposes.

**Table 4: Worst-Case 65 and 70 dBA Contour Distances (in feet)**

Build Alternative	400 North to Colorado River Bridge	Colorado River Bridge to Potash Road
	Approximate distances to 65 dBA contour line / 70 dBA contour line*	
Year 2030	140 / 60	270 / 130

Notes:

\* Distance measured from the proposed roadway centerline, rounded to the nearest ten feet, varies slightly based on typicals. This is a straight-line estimate for planning purposes only. It does not take into account sound level variations as a result of numerous local sound wave changing dynamics such as building shielding, terrain, tree zones, and ground zone changes. It does, however, incorporate the effects of the additional noise reflective pavement proposed from the construction of center turning lanes, shoulders, and bike paths, as applicable.

Source: Michael Baker Jr., Inc.

## 11.5 SOUND INSULATION FOR PUBLIC INSTITUTIONS

There are zero (0) public institutions that meet this criteria. Therefore, no further analysis is required for this type of abatement.

## 11.6 NOISE BARRIERS

UDOT is committed to providing feasible and reasonable noise abatement as a result of highway traffic noise. In determining this feasibility and reasonableness, appropriate consideration shall be given to UDOT's Traffic Noise Abatement policy (UDOT 08A2-1; revised March 8, 2004) and the June 1995 Policy and Guidance issued by the Federal Highway Administration regarding, "Highway Traffic Noise Analysis and Abatement."

A key measure of feasibility states that a noise barrier shall reduce traffic noise levels generated on the facility by a minimum insertion loss of 5 dBA at the closest receptor(s). An insertion loss is defined as a decibel level reduction (loss) from an insertion of a barrier between the roadway and the sensitive receptors.

This condition was achieved at two of the impacted site areas (receptors 17 and 20, both single family homes). It was not achieved where cross-street and driveway access points had to be maintained. The primary reason is that proposed noise abatement structures would be constrained by the need to maintain access to these cross-streets and / or driveways. Subsequently, resulting 'gaps' in proposed barriers would render them ineffective (not feasible) in an effort to meet the minimum goal of 5 dBA. There would also be the need to maintain line-of-sight safety requirements (sight triangles) in these cases.

Based on the recent three-year cost index that UDOT uses to estimate noise barrier costs, the square foot outlay is estimated to be approximately \$14 per square foot, not including ancillary costs such as right-of-way, landscaping, utilities, structure mounted barriers, etc. The UDOT cost limit per benefited receptor is approximately \$25,000 for reasonableness. The two impacted feasible receptor sites did not meet UDOT's cost-reasonableness criteria.

The mitigation consideration assessments are discussed in **Table 5**. Additionally, areas that were deemed to not be feasible under UDOT policy are also discussed.

**Table 5. Preliminary Noise Abatement Mitigation Summary**

RECEPTORS	EVALUATION COMMENTS
1-Days Inn at pool	<p>The motel has direct access to US-191. The exterior people activity is at the pool, which is ~35-40 feet from the edge of pavement. The pool area also abuts the motel driveway. Current peak hour sound levels are 66 dBA and the predicted design year No Build Alternative is 67 dBA as a result of the increased traffic volumes and the proposed posted speed change. With the design year Build Alternative, there is no change in the number of through lanes, posted speed or traffic volumes in front of this receptor. It is in the current four-lane section. Therefore, the sound levels are predicted to remain at 67 dBA.</p> <p>Nonetheless, driveway access would need to be maintained and a continuous noise barrier would restrict access to these receptors. Gaps in a noise barrier would satisfy the access requirements but the resulting non-continuous segments would not be sufficient to achieve the minimum feasible reduction of 5 dBA for the impacted receptor. There would also be safety line-of-sight requirements for the access point. Furthermore, as a commercial entity, it is not typical that any such establishment would desire to have its view blocked from the general public for business reasons.</p>
5-Hampton Inn at pool	<p>The motel has direct access to US-191. The exterior people activity is at the pool, which is ~70 feet from the edge of pavement. The pool area is also ~80 feet from the motel's driveway and is surrounded by the motel's internal circulation road. Current peak hour sound levels at this proposed motel are 63 dBA and the predicted design year No Build Alternative sound level is 64 dBA as a result of the increased traffic volumes and the proposed posted speed change.</p> <p>This receptor is in the existing four-lane to two-lane transition zone. With the design year Build Alternative, the northbound travelway is moved slightly closer to the motel, resulting in a predicted sound level of 65 dBA, a 1 dBA increase over the No Build Alternative.</p> <p>Nonetheless, driveway access would need to be maintained and a continuous noise barrier would restrict access to this site. A gap in the noise barrier would satisfy the access requirements but the resulting non-continuous segments would not be sufficient to achieve the minimum feasible reduction of 5 dBA for the impacted receptor. There would also be safety line-of-sight requirements for the access point. Furthermore, as a commercial entity, it is not typical that any such establishment would desire to have its view blocked from the general public for business reasons.</p>
3A-Moab Desert Adventures	<p>These five adjacent commercial businesses each have multi-access points to US-191 and the travel lanes are very close to the businesses. There are no exterior people activity areas at these sites (parking lots do not count). Therefore, if an exterior to interior conversion was made (a 25 dBA subtraction), then none of these receptors would be impacted according to the Category E interior approach criteria of 50 dBA. Current exterior peak hour sound levels are ~70-71 dBA and the predicted design year No Build Alternative sound levels increase by approximately one dBA. There is no change in the number of through lanes in front of these receptors since it is in the current four-lane section. These sound levels are predicted to have a predicted increase of 0-&lt;1 dBA.</p> <p>Nonetheless, driveway access would need to be maintained and a continuous noise barrier would restrict access to these receptors. Gaps in a noise barrier would satisfy access requirements but the resulting non-continuous segments would not be sufficient to achieve the minimum feasible reduction of 5 dBA for the impacted receptor. There would also be safety line-of-sight requirements for the numerous access points. Furthermore, as commercial entities, it is not typical that any such establishments would desire to have their view blocked from the general public for business reasons. Additionally, under UDOT R930-3-5 Noise Abatement Conditions (3) (e), Noise abatement shall not be planned for Land Use Category C.</p>
6-Cycle Shop	
7-Maverick Shop	
9-Poison Spider	
10-Century 21	

**Table 5. Preliminary Noise Abatement Mitigation Summary (continued)**

RECEPTORS	EVALUATION COMMENTS
11-Adventure Inn Moab Motel	<p>The motel has direct access to US-191 and may be partially taken as part of the right-of-way requirements. There is no exterior people activity at this location, but there is an on-site residence located within the Inn's office building. Current peak hour sound levels are 70 dBA at the building's nearest location to US-191 and the predicted design year No Build Alternative is 71 dBA. (The rear building is not predicted to have a noise impact.) This receptor is at the northern end of the current four-lane to two-lane transition zone. The design year build alternative sound levels are predicted to remain at 71 dBA. The office location is unshielded, but the sound levels at the on-site residence area are shielded by the office and other hotel building. Existing sound levels for the residence were calculated to be 60 dBA, and the No Build and Build sound levels were predicted to be 61dBA.</p> <p>Nonetheless, if this property is not acquired, driveway access would need to be maintained and a continuous noise barrier would restrict access to these receptors. Gaps in a noise barrier would satisfy access requirements but the resulting non-continuous segments would not be sufficient to achieve the minimum, feasible reduction of 5 dBA for the impacted receptor. There would also be safety line-of-sight requirements for the access point. Furthermore, as a commercial entity, it is not typical any such establishment would desire to have its view blocked from the general public for business reasons.</p>
13A Office Building at 550 North Main	<p>The four commercial businesses currently within this single office building have direct access to US-191 and the travel lanes are very close to the building. There are no exterior people activity areas at these sites (parking lots are not considered an activity area). Therefore, if an exterior to interior conversion was made (a 25 dBA subtraction), then none of these receptors would be impacted according to the Category E interior approach criteria of 50 dBA. Current exterior peak hour sound levels are 70 dBA and the predicted design year No Build Alternative sound levels increase by approximately one dBA. This receptor is at the northern end of the current four-lane to two-lane transition zone. These sound levels are predicted to have an increase of 0-&lt;1 dBA over the No-Build Alternative.</p> <p>Nonetheless, driveway access would need to be maintained and a continuous noise barrier would restrict access to this receptor site. Gaps in a noise barrier would satisfy access requirements but the resulting non-continuous segments would not be sufficient to achieve the minimum feasible reduction of 5 dBA for the impacted receptor. There would also be safety line-of-sight requirements for the numerous access points. Furthermore, as commercial entities, it is not typical that any such establishments would desire to have their view blocked from the general public for business reasons. Additionally, under UDOT R930-3-5 Noise Abatement Conditions (3) (e), Noise abatement shall not be planned for Land Use Category C.</p>
17 & 20, Residences; 3 Rosalie Court, 2 Rosalie Court	<p>These two residences are located at the end of the Rosalie Court cul-de-sac with no direct access to US-191 and their back or side yards abutting US-191. An initial eight-foot high and 800-foot long barrier was analyzed to cover flanking around the barrier. It was possible to achieve the minimum barrier insertion sound level reduction of 5 dBA for both sites (6 dBA and 8 dBA for Sites 17 and 20, respectively.). These two homes were the only ones able to get the minimum reduction because the others were farther away. The other non-impacted homes had predicted reductions ranging from 1-4 dBA. But at a total cost of ~\$88,700, the cost per benefited receptor was \$44,350, which is above UDOT's cost reasonableness value of \$25,000.</p> <p>Shorter barrier lengths were investigated with the eight-foot height to bring the cost down and still meet the minimum reduction. (Lower barrier heights would not have achieved the minimum.) However, the shortest length needed to meet the minimum 5 dBA reduction for the two impacted homes was 500 feet. At a cost of ~\$56,100, the cost per benefited receptor was \$28,050, which is above UDOT's cost reasonableness policy criteria. Furthermore, the TNM Line of Sight analysis indicates that this barrier dimension would not mitigate for truck exhaust stack noise, though the barrier would still reduce the noise by the minimum 5 dBA by mitigating the tire and engine noise sources.</p>

Source: Michael Baker Jr., Inc.

## 11.7 CONCLUSIONS

In accordance with UDOT's Traffic Noise Abatement policy (UDOT 08A2-1; revised March 8, 2004)), noise abatement walls are not proposed for this project for the following reasons.

Generally:

- The minimum decibel reduction goal of 5 dBA can not be achieved at most impacted locations.
- Where the minimum 5 dBA reduction was achieved, the predicted costs were above the UDOT cost reasonableness criteria for benefited receptors.
- Direct access to driveways and cross-streets must be maintained and can not be restricted with noise barriers placed across these ingresses and egresses.
- Line-of-sight safety requirements must be maintained and can not be compromised for those vehicles that would be turning from the driveways and/or side streets onto US 191.

## 12.0 CONSTRUCTION NOISE ABATEMENT

---

The potential for temporary increases in the sound level environment because of construction activities is expected to occur at the studied receptor sites. Although temporary, there will be occurrences where construction noise is perceptible to the general public. This analysis is consistent with Federal Regulation 23 CFR 772 - Procedures for Abatement of Highway Traffic Noise and Construction Noise and Utah Code 72-6-111 and 112.

Generally, the control, timing, and phasing of construction noise will be governed by UDOT construction specifications. The project falls within a "noise sensitive zone" (the land enclosed within a 1,500 foot radius circle of any receptor) as defined by UDOT construction standard specification Section 01355 (Environmental Protection) Part 1.8 Noise and Vibration Control. This specification states that the contractor will be required to prohibit construction activity in a noise sensitive zone if the sound level within 10 feet of the nearest receptor exceeds 95 dBA in daytime (from 7 am to 9 pm) or 55 dBA in nighttime (from 9 pm to 7 am), as well as Sundays and State Holidays.

Construction noise levels would not be continuous for any given receptor but would be intermittent and vary by location. For example, a receptor may experience noise due to removal / excavation, drainage installations, and paving operations at different timeframes during the construction. Furthermore, these disruptions could occur while these activities are performed in a northbound direction, and then again for construction in the southbound direction. These individual disruptions should be for a limited period of time.

**Table 6** shows the typical sound levels for construction equipment normally used in highway construction operation.

**Table 6: Typical Construction Equipment Noise**

<b>Equipment</b>	<b>Typical Noise Level (L<sub>eq</sub> dBA) 50 Feet from Source</b>
<i>Earth Moving</i>	
Front Loader	85
Back Hoe	80
Dozer	85
Scraper	89
Grader	85
Truck	88
Paver	89
Scarifier	83
Shovel	82
<i>Materials Handling</i>	
Concrete Mixer	85
Concrete Pump	82
Crane, Mobile	83
Crane, Derrick	88
<i>Stationary</i>	
Pump	76
Generator	81
Air Compressor	81
<i>Impact</i>	
Pile Driver (Impact)	101
Pile Driver (Sonic)	96
Jackhammer	88
Rock Drill	98
<i>Other</i>	
Saw	76
Vibrator	76
Compactor	82
Pneumatic Tool	85
Roller	74

Source: EPA, Northeast Corridor Improvement Project and other measured data.

## **APPENDIX A**

### **PREDICTED EXTERIOR SOUND LEVELS (dBA) EXISTING AND DESIGN YEAR CONDITIONS**

<b>Receptor # and Location</b>	<b>2005 Noise Level</b>	<b>2030 No Build Noise Levels</b>	<b>2030 Build Noise Levels</b>	<b>2030 Noise Level with Abatement</b>	<b>Reasonable and Feasible?</b>
1-Days Inn at pool	66	67	67	N/A	N/A
2-Jeep Rental	68	69	69	N/A	N/A
3-A&B Auto	66	67	68	N/A	N/A
3A-Moab Desert Adventures	70	71	71	N/A	N/A
4-Expedition Shop	69	69	69	N/A	N/A
5-Hampton Inn at pool	63	64	65	N/A	N/A
6-Cycle Shop	70	71	71	N/A	N/A
7-Maverick Shop	71	72	72	N/A	N/A
8-Church of Christ	56	57	58	N/A	N/A
9-Poison Spider	70	71	71	N/A	N/A
10-Century 21	70	71	71	N/A	N/A
11-Adventure Inn Moab Motel	70	71	71	N/A	N/A
12-Hummer Tours	67	68	69	N/A	N/A
13-North Main Shopping Center	62	63	66	N/A	N/A
13A-Office Building at 550 North Main	70	71	71	N/A	N/A
14-Rock Shop	66	67	68	N/A	N/A
15-Residence; Cermak Drive	57	59	62	N/A	N/A
16-Residence; Cermak Drive	54	56	60	N/A	N/A
17-Residence; 3 Rosalie Court	64	66	67	62	No
18-Residence; 4 Rosalie Court	58	60	61	N/A	N/A
19-Residence; 5 Rosalie Court	56	59	61	N/A	N/A
20-Residence; 2 Rosalie Court	65	67	68	62	No
21-Residence; 1 Rosalie Court	58	61	63	N/A	N/A
22-Residence; 646 Mivida Drive	57	59	61	N/A	N/A
23-Residence; 654 Mivida Drive	57	60	62	N/A	N/A
24-Residence; Mivida Drive	55	58	60	N/A	N/A
25-Residence; Hobbs Street	57	60	61	N/A	N/A
26-Residence; Hobbs Street	57	59	61	N/A	N/A
27-Residence; Hobbs Street	58	60	62	N/A	N/A
28-Residence; Hobbs Street	58	61	62	N/A	N/A
29-Residence; Hobbs Street	58	60	62	N/A	N/A
30-Residence; Hobbs Street	58	60	61	N/A	N/A
31-Residence; Hobbs Street	58	60	60	N/A	N/A
32-Residence; Hobbs Street	55	58	59	N/A	N/A
33-Residence; Marcus Court	56	58	59	N/A	N/A
34-Residence; 350 Marcus Court	60	63	64	N/A	N/A
35-Residence; Marcus Court	59	62	63	N/A	N/A
36-Residence; Marcus Court	57	60	61	N/A	N/A
37-Residence; Marcus Court	56	58	60	N/A	N/A
38-Riverside Inn at pool	57	59	62	N/A	N/A
39-Super 8 Motel at pool	58	61	62	N/A	N/A
40-Denny's	65	68	68	N/A	N/A
41-Residence; Westwood Avenue	54	56	59	N/A	N/A
42-Residence; N 500 W	59	61	63	N/A	N/A

43-Black Oil Co.	58	60	62	N/A	N/A
44-Residence; US-191	60	62	64	N/A	N/A
45-Arthur Taylor House-Restaurant-Planned hotel	57	59	61	N/A	N/A
46-Moab Springs Dwelling Units; front	61	63	64	N/A	N/A
47-MSDU; front	55	57	58	N/A	N/A
48-MSDU; front	54	57	58	N/A	N/A
49-MSDU; second row	53	55	57	N/A	N/A
50-MSDU; second row	51	53	56	N/A	N/A
51-MSDU; second row	50	52	56	N/A	N/A
52-MSDU; second row	50	53	56	N/A	N/A
53-MSDU; second row	51	53	57	N/A	N/A
54-MSDU; second row	51	53	57	N/A	N/A
55-MSDU; second row	51	53	57	N/A	N/A
56-Red River Raft	62	64	65	N/A	N/A
57-Bucks Grillhouse	61	63	64	N/A	N/A
58-Slick Rock Campground & RV Park at pool	61	63	64	N/A	N/A
59-Butch Cassidy Waterpark	57	59	62	N/A	N/A
60-Holiday Inn Express	57	59	61	N/A	N/A
61-Aarchway Inn at pool	48	50	50	N/A	N/A
62-Moab Valley River Camp Park at pool/recreation area	57	60	61	N/A	N/A
63-Lions Park at pavillion	57	60	62	N/A	N/A
64-Canyonlands By Night Tours	56	58	61	N/A	N/A
65-Riverside Oasis Campground & RV Park	55	57	63	N/A	N/A
66-Motel 6 at pool	60	62	63	N/A	N/A
67-Bank-Credit Union	63	66	67	N/A	N/A
68-Anasazi Real Estate	63	65	67	N/A	N/A
69-Proposed Motel	57	59	61	N/A	N/A

*Note1: Shaded areas indicate receptors that equal or exceed UDOT's approach criteria for either NAC B (65 dBA) or NAC C (70 dBA) categories. There are zero (0) predicted substantial increase criteria impacts.*

*Note2: Sound level values are rounded off.*

*N/A = Not Applicable for reasonableness and/or feasibility reasons such as access restrictions, line of sight (safety), additional right-of-way required, and/or cost per benefited receptor.*

*This page is intentionally blank.*